934,169

PATENT SPECIFICATION

DRAWINGS ATTACHED

934,169

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COMPLETE SPECIFICATION

Aircraft

I, LEONOR ZALLES FREELAND, a citizen of the United States of America, of 4803, Grantham Avenue, Chevy Chase 15, Maryland, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to aircraft and more particularly to aircraft capable of vertical flight, hovering and lateral flight.

An object of this invention is to provide an aircraft having an improved control system and propulsion system embodying a simplified air discharge duct system for the discharge of air under pressure.

Briefly an aircraft in accordance with the invention has an annular chamber defined between upper and lower panels. The chamber has a number of air inlet openings, air motors being provided for drawing air into the chamber by way of the air inlet openings.

There are a plurality of groups of air discharge ducts registered with the chamber and each duct has a first passageway which opens laterally outwardly of the aircraft body, together with a second passageway which opens downwardly of the same aircraft body. The groups of air discharge ducts are arranged to extend radially outwardly from the central vertical axis of the aircraft body, and the ducts are capable of producing propulsion and/or control forces in a horizontal plane, assuming a perfectly level attitude of the aircraft. The remaining passageways open downwardly and all the passageways are located in groups arranged in a circular pattern concentric with the vertical axis of the aircraft. When air is expelled from the downwardly extending ducts under a high velocity and pressure, upward forces are produced. Furthermore, control of roll and pitch may be obtained by regulating control valves which are provided in the downwardly opening passageway, while forward, aft, port and starboard control forces may be obtained by adjusting air valves in the lateral ducts. Various combinations of forces about the horizontal axes of the aircraft may be obtained by various adjustments of the control valves due to the arrangement of the groups of ducts.

The two passageways of each duct are under the control of a deflector which apportions air between the lateral and the downward passageways in accordance with the necessities as judged by the pilot. In this way, i.e. with the control valves for the passageways and the deflectors between passageways, control forces for the aircraft are obtained.

A preferred embodiment of the invention is described, merely by way of example, with reference to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:—

Figure 1 is a side elevational view of an aircraft constructed according to the invention, parts broken away in section to illustrate otherwise obscure details;

Figure 2 is a top view of the aircraft in Figure 1;

Figure 3 is an enlarged sectional view showing one group of ducts of the aircraft;

Figure 4 is an elevational view of a portion of the aircraft body, certain parts shown in section to illustrate the construction of duct; and

Figure 5 is a diagrammatic view showing one possible method of control for the various ducts.

In the accompanying drawings there is an illustration of an aircraft 10 having a body 12. The aircraft body has an upper wall or panel 16 which is circular in plan form and which is convex. A lower wall or panel 18 is connected by an inner wall 20 forming an inner continuation of wall 18, to panel 16. The panels 16 and 18 are spaced from each other to define an annular chamber 22 which is an air compression chamber. A peripheral

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wall 26 is at the edges of the panels 16 and 18, and there is an internal bracing 28 for the body of the aircraft. The internal bracing 28 is in the form of a continuous circular and transversely curved wall and cooperates with an adjacent portion 30 of panel 18 to form a throat 32 of smaller cross-sectional area than chamber 22.

There are four motors 34, 36, 38 and 40, and these motors may be of any desired type such as electric motors or internal combustion engines. Each motor has a propeller 42 connected therewith, and in those cases where axial flow motors are used, no propeller will be required. Suitable motor mounts 44 are secured to the motors and to panel 18 rigidly and firmly supporting the motors with propellers 42 located in the four air inlet openings 48, 50, 52 and 54 which are formed in the panel 16 and which are located on a pair of horizontal axes perpendicular to one another.

There are four groups 58, 60, 62 and 64 of air discharge ducts registered with the passage 32, and the groups are located on the horizontal axes which were mentioned previously. A typical group 58 of ducts is shown in detail in Figures 3 and 4. This group contains five ducts 68, 70, 72, 74 and 76, and the ducts are substantially radially arranged with respect to the longitudinal axis of the aircraft body 12. Although the ducts may be made annular or circular in cross-section, they are shown rectangular in cross section, and each duct, for instance duct 72 has a pair of side walls 78 and 80, a bottom wall 82 and a top wall 84. As shown in Figure 4 the ducts are in the form of venturi tubes or at least, modified venturi tubes. Further, the described duct 72 has walls 78, 80, 82 and 84 defining a lateral passageway 88 which opens through wall 26 at one end and which opens into or at least communicates with chamber 22 at the other end. The longitudinal axis of passageway 88 is essentially horizontal when the aircraft is in a straight and level attitude. The duct 72 has a downwardly opening passageway 90 defined by four walls 92 arranged in rectangular formation. The longitudinal axis of passageways 88 and 90 intersect at approximately right angles to each other.

A control deflector 94 is mounted for rotational adjustment at the intersection of the passageways 88 and 90, and it is in the form of a vane attached to a shaft 96. The vane is capable of swinging between positions shown in Figures 1 and 4 respectively i.e. at which the air from chamber 22 flows through either passageway 88 or passageway 90. In an intermediate position of adjustment the air is aportioned between passageways 88 and 90. Figure 3 shows that the five deflectors 94 for the five ducts have their shafts 96 coupled together by means of universal joints 98 so that all deflectors operate in unison i.e. all of the deflectors for one group 58 of ducts. This invention contemplates utilizing separate or individual controls and control means for the various deflectors in different groups of ducts.

A control valve 100 is mounted in passageway 88 and a control valve 102 is mounted in passageway 90. The control valves each comprise at least one rotatable butterfly valve. The control valve 100 is secured to a shaft 104, while control valve 102 is secured to shaft 106. Shaft 104 is coupled to the adjacent shafts of the adjacent ducts by means of universal joints 108 so that all of the corresponding valves 100 are operative in unison. The same holds true for the valve 102. Each of the downwardly opening passageways of each of the ducts has a control valve 102 therein, and the control valves 102 for one group of ducts are coupled together by shafts and universal joints so that they are operated in unison.

Referring now to Figure 5, this figure is a diagrammatic representation of an electrical system for operating the deflectors of the four groups and the control valves of the four groups of ducts. Other means may be resorted to for causing the deflectors and valves to be operated. The illustration in Figure 5 shows an electrical power supply 112 with a power line 114 extending therefrom. There are three control switches 116, 118 and 120, all energized from power line 114, and these are secured to three motors 122, 124 and 126. The motor 126 is mechanically coupled, for example by a reduction gear, to the shafts 106 causing operation of deflectors 102. Motor 124 is drivingly connected with shafts 96 to actuate all of the deflectors 94. Motor 122 is mechanically coupled to shaft 104 in order to cause all of the control valves 100 of one group to operate. It is evident that there are similar controls for the remaining groups 60, 62 and 64 of ducts and more particularly, the control elements in the passageways thereof. The disclosed system is ideally suited for operation by a conventional gyroscopic system such as an automatic pilot.

In operation the motors 34, 36, 38 and 40 are energized so as to rotate propellers 42. Air is drawn in the inlets 48, 50, 52 and 54 and enters chamber 22. Assume a vertical take-off is desired. All of the control deflectors 94 are adjusted to the position shown in Figure 1 at which all passageways 88 are blocked. The total quantity of air will then flow through passageways 90 and the control valves 102 will be opened as shown in Figure 1. Assume now that forward motion is desired. The deflectors for the group 62 of ducts are adjusted to the position shown in Figure 4 at which the total quantity of air will be discharged rearwardly of

the aircraft and in an approximately horizontal plane. The deflectors 94 of group 58 may be in any position since valves 100 and 102 thereof must be closed. The same holds true for the passageways of the groups 60 and 64 of ducts. Such a condition is satisfactory for taxiing on an airfield, however, to sustain flight and have forward propulsion, the deflectors 94 must be adjusted to the position shown in Figure 1, and the valves 102 of groups 60 and 64 must be opened to provide an upward component of force. Rolling moments are obtained by opening the valves 102 of ducts 60 and 64 more than the other. A pitching moment is obtained by opening to a different degree the valves 102 of the ducts of the groups 58 and/or the group 62. In order to obtain the equivalent of yaw control, air is permitted to discharge from the lateral passageways 88 of the groups 60 and 64 of ducts. When coupled with a force derived from the lateral passageways 88 of the group 62 of ducts, the resultant force will move the aircraft to the left or to the right, and the amount of deviation from forward flight will be dependent upon the magnitude of the comparative forces tending to move the aircraft to the side and forwardly respectively. These are normally all of the control forces that are required for take-off, landing, hovering and lateral flight, since the aircraft is symmetrical in exterior shape about any plane containing its vertical axis and has a smooth exterior surface as shown in the drawings. Therefore, there are no external forces tending to rotate the aircraft. However, if it is desired to cause or control rotation of the aircraft about its vertical axis, this may be accomplished by providing aircraft with conventional and well known yaw control devices. The attitude of the aircraft may be altered by adjusting in unison the valves 102 of a particular group. This applies to the fore, aft, starboard and port sides. Arbitrarily assuming that the aircraft has a front end and a rear end (which may be at any two points on its periphery), it is equite evident that since the aircraft is symmetrical, it is capable of flying to the left, to the right, forward, rearward, or directions between these main directions with equal facility.

WHAT I CLAIM IS:—

1. An aircraft having a body provided with an upper panel and a lower panel defining an annular chamber, said upper panel having a plurality of air inlet openings arranged around the vertical axis of said chamber, air moving motor means in said openings to draw air into said chamber, a plurality of groups of air discharge ducts registered with the chamber, each duct branching into a first passageway which opens laterally outwardly of said body and a second passageway which opens downwardly of said body, and a control deflector at the juncture of said passageway to direct air from said chamber selectively into said first and second passageways.

2. An aircraft according to Claim 1 wherein the upper panel is circular in platform and has a convex shape, a peripheral wall joining the outer edges of the upper and lower panels.

3. An aircraft according to Claim 1 or 2 wherein the air inlet openings extend vertically through the upper panel and the motor means comprise a plurality of motors carried by the body for drawing air through the inlet openings and into the annular chamber.

4. An aircraft according to Claim 1, 2 or 3 wherein the groups of air discharge ducts are circumferentially spaced about the body and communicate at their inner ends with said chamber, each duct having a horizontal passageway opening through a peripheral wall joining the outer edges of the upper and lower panels and a vertical passageway opening through the lower panel, said passageways having longitudinal flow axes intersecting adjacent to said chamber, and the control deflector being movably mounted adjacent to the intersection of said axes so as to be moveable to apportion airflow from the chamber through said horizontal and vertical passageways and to be completely contained within said passageways during all phases of its movement.

5. An aircraft according to any preceding claim wherein the air moving motor means comprises a plurality of power driven propellers, each individual propeller being rotatable about a vertical axis in one of the air inlet openings.

6. An aircraft according to any preceding claim wherein there are control valves in each passageway for selectively closing, opening and restricting same to exercise an additional flow control function over the flow through the passageways.

7. An aircraft according to Claim 6 wherein each control valve comprises at least one rotatable butterfly valve.

8. An aircraft according to Claim 7 wherein each group of ducts comprises a plurality of side-by-side and slightly diverging horizontal and vertical passageways, each passageway containing one of the butterfly valves, the valves in each group of passageways being rotatably mounted on shafts having their adjacent ends connected by universal joints and one of the valves in each group of passageways having its shaft connected to power means.

9. An aircraft according to any preceding claim wherein the selector valve is arcuate in cross-section.

10. Aircraft constructed and arranged substantially as herein described with reference to and as illustrated in the accompanying drawings.

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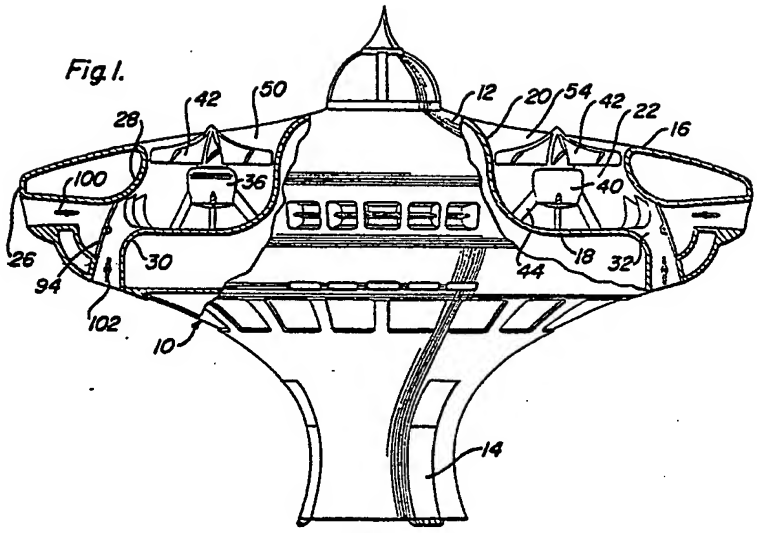
Fig. 1.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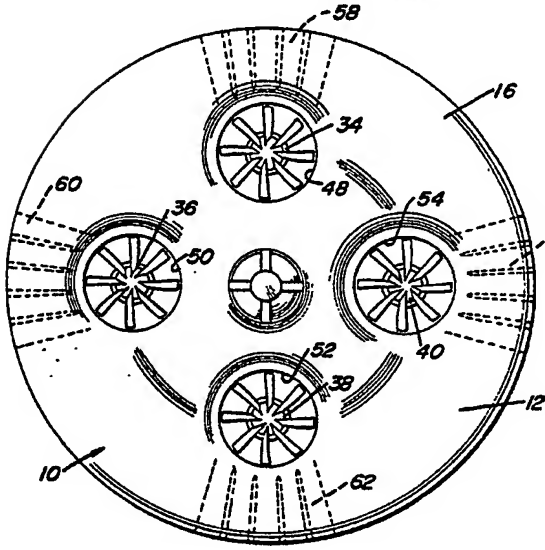
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Fig. 2.

934169 COMPLETE SPECIFICATION
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Sheets 1 & 2

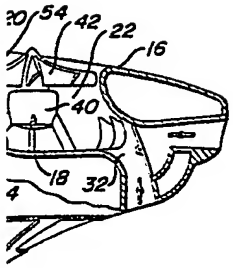


Fig. 2.

Fig. 3.

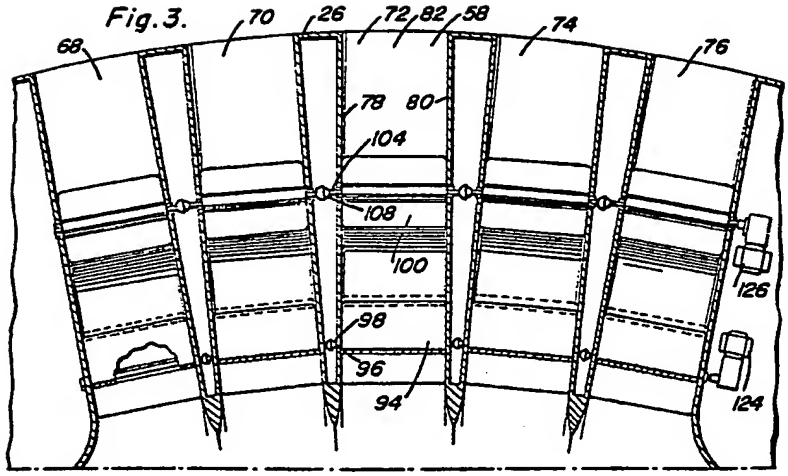
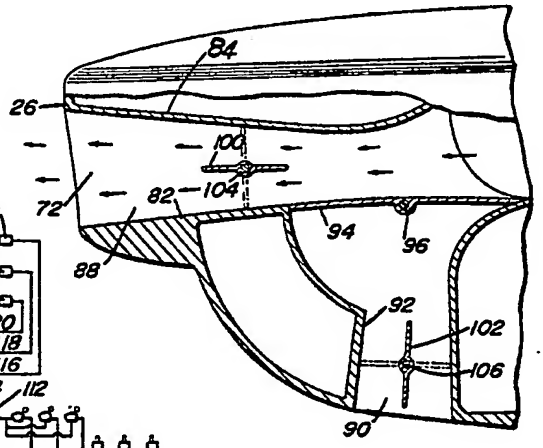


Fig. 4.



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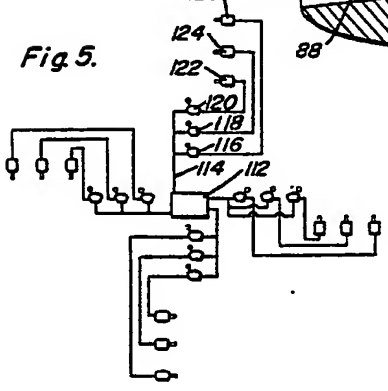

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

Fig.1.

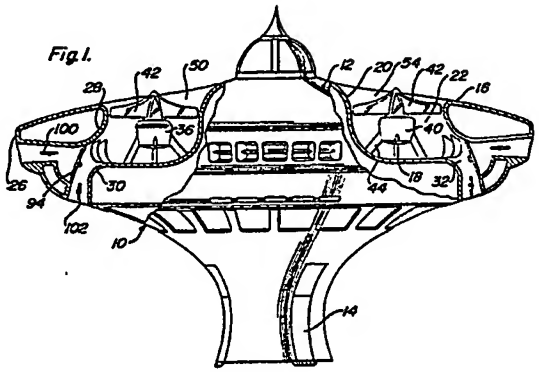

Fig.2.

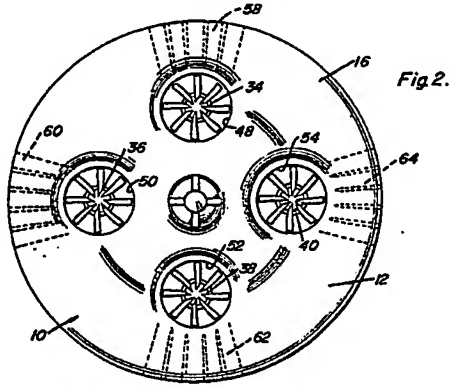

Fig.3.

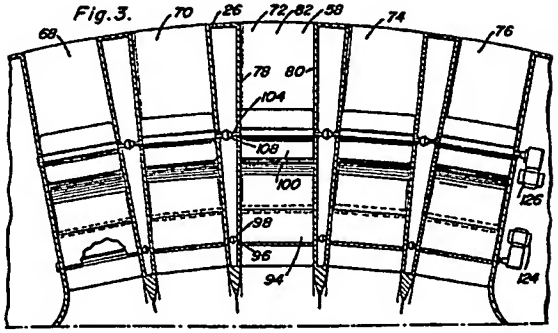

Fig.4.

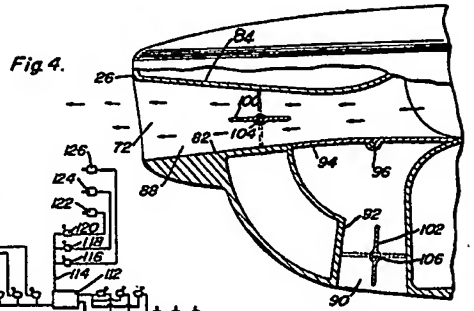

Fig.5.